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ABSTRACT

This document presents keystrokes for the Texas Instrument (TI-83) graphing calculator. After presenting some basic TI-83 keystrokes, activities for student practice are listed. This is followed by keystrokes for TI-83 advanced functions such as evaluating function values, finding the zero of a function, finding the intersection of two graphs, graphing piecewise-defined functions, and multiplying matrices. (ASK)

TI-83 GRAPHING CALCULATOR KEYSTROKE GUIDE

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TI-83 CALCULATOR BASICS

(1) To turn the calculator on, press [ON] . This is the home screen.

(2) To adjust the contrast, press [2nd] [△] to darken the screen or [2nd] [▽] to lighten the screen. Hold down the arrow key until the contrast is adjusted.

(3) Type some numbers on the screen. To erase this line, press [CLEAR] . Type anything on the screen and press [ENTER] . Do this again. To erase everything that you've typed on the home screen, press [CLEAR] . The CLEAR key can be used to erase a line (if you haven't pressed enter) or to erase the entire home screen.

(4) To access functions listed above the keys in gold, press [2nd] before pressing the key. For example:

(a) Press [Y=] . To return to home screen, press [2nd] [ ] (QUIT)

(b) To turn off the calculator, press [2nd] [ ] (OFF)

(5) To access the green letters above the keys, press [ALPHA]

before pressing the key. For example, to type the letter A,

press [ALPHA] [A] .

(6) If you press [2nd] or [ALPHA] by mistake, you can cancel the option by pressing the key again. Notice how the cursor changes when you press these keys and changes back to the standard cursor when you press them again.

(7) Evaluate: $8 \div 4 \times 2$

[8] [÷] [4] [×] [2] [ENTER]

The ENTER key is equivalent to an equal sign.

(Answer: 4)

(8) Evaluate: $\frac{1}{3} + \frac{2}{5}$

[1] [÷] [3] [+] [2] [÷] [5] [ENTER] .

(Answer: 0.733...)

To express your answer as a fraction, press [MATH] [1] [ENTER]

(Answer: 11/15)

(9) Evaluate: $-5^2 - 6.4$

(-) 5 x^2 - 6.4 ENTER

(Answer: -31.4)

(10) Evaluate: 7^3

7 ^ 3 ENTER

(Answer: 343)

(11) Evaluate $7^5 + 44$ by editing the previous entry.

ENTRY

2nd [ ] ◁ 5 + 44 ENTER .

(Answer: 16851)

(12) Multiply the previous answer by 2.54

× 2.54 ENTER

(Answer: 42801.54)

(13) Substitute the previous answer for x in $x^2 - x$

ANS

x^2 - 2nd [ ] ENTER

(Answer: 1831929025)

(14) Evaluate: $|-4| + \sqrt{7}$

$\sqrt{\ }$

MATH ▷ 1 (-) 4) + 2nd [ ] 7) ENTER

(Answer: 6.645751311)

(15) Edit the previous expression to say $|4| + \sqrt[3]{7.5}$

ENTRY

[2nd] [ ] [◁] [◁] [◁] [◁] [◁] [◁] [◁] [DEL] [▷] [▷] [▷] [MATH] [4]

INS

[▷] [2nd] [ ] [.5] [ENTER]

(Answer: 5.957433821)

(16) Suppose you typed the following to evaluate 15 - 49:

[15] [(-)] [49] [ENTER]

An error message appears on the screen. Type [2] for the cursor to position itself on the error. Type [-] [ENTER] to correct it. The calculator interprets a negative sign differently than a minus sign.

(Answer: -34)

(17) Evaluate $\ln \pi + \sqrt[5]{40}$

π

[ln] [2nd] [ ] [)] [+] [5] [MATH] [5] [40] [ENTER]

(Answer: 3.236008991)

(18) Find the z-score in a statistics course by evaluating

$$\frac{87 - 72.4}{9.7}$$

[( ] [87] [-] [72.4] [ )] [÷] [9.7] [ENTER]

(Answer: 1.505154639)

(19) Evaluate $e^{27 - 9}$

e^x

[2nd] [ ] [2] [^] [7] [-] [9] [ )] [ENTER]

(Answer: $4.797813327 \times 10^{51}$)

(20) Graph $y = x^2 + x - 6$

[Y=] [CLEAR] [X,T,θ,n] [x^2] [+] [X,T,θ,n] [-] [6] [GRAPH]

If the graph doesn't appear on the screen, press [ZOOM] [6] to reset the viewing window to its standard settings.

Press [TRACE] and use the left arrow key to move the blinking cursor to find the missing coordinate of the ordered pair (-1.914894,_____). Use the right arrow key to find the missing coordinate of the ordered pair (_____,7.3770937).

[Answer: (-1.914894,-4.248076), (3.1914894,7.3770937)]

(21) Graph these equations in the same plane: $y = x^3 - 2x$
$y = 2\cos x$

Y= CLEAR X,T,θ,n ^ 3 - 2 X,T,θ,n ENTER

2 cos X,T,θ,n) GRAPH

At how many places do these graphs intersect? Zoom in on the left-hand point where they appear to intersect by pressing ZOOM 1 . A blinking cursor will appear. Use the arrow keys to move the blinking cursor above and to the left of the point in question. Press ENTER . This is the upper left hand corner of the zoom box. Press the down arrow and right arrow keys until the box contains the point in question. Press ENTER . Follow the zoom procedure again if needed. The blinking cursor is already on the screen, so it is not necessary to press the ZOOM key again. Simply position the cursor above and to the left of the point and create another box. It should now be apparent that the graphs do not intersect at this point.

(22) Clear equations above and examine the standard viewing window.

Y= CLEAR ▽ CLEAR ZOOM 6 WINDOW

This shows that the x-axis and y-axis span the values -10 to 10 with a distance between tick marks of 1. The viewing rectangle can be changed by changing these values. The Xres

sets the pixel resolution (1 through 8) for graphing functions. At Xres = 1, the functions are graphed at each pixel on the x-axis which gives the most accurate graph. At Xres = 8, functions are graphed at every eighth pixel along the x-axis which causes a loss of accuracy but a gain in the speed in which the graph is drawn.

(23) When graphing an equation on the calculator, all of the important features of the graph should appear on the screen. Often the viewing rectangle must be changed to find all the important features.

For example, graph $y = 2x^4 - x^2$.

[Y=] [2] [X,T,θ,n] [^] [4] [-] [X,T,θ,n] [x^2] [GRAPH]

In this viewing window it is not possible to tell how the graph behaves around the origin. To inspect the graph near the origin, the span of x-values and y-values in the viewing window must be decreased. Try the following values:

[WINDOW] [-2] [ENTER] [2] [ENTER] [0.5] [ENTER] [-1] [ENTER] [2] [ENTER] [0.5] [GRAPH]

This viewing window shows all the important features of the graph.

(24) Graph the equation $y = x^4 - 401x^2 + 400$

Y= CLEAR X,T,θ,n ^ 4 - 401 X,T,θ,n x^2 +

400 ZOOM 6

Is this a good viewing window? The large coefficients indicate the y-values in the viewing window must be increased substantially. Try the following y-values:

WINDOW ▽ ▽ ▽ -6000 ENTER 6000 ENTER 1000 GRAPH

Are all the important features of the graph shown? A table of values can help answer this questions and help to find a good viewing window.

Press 2nd TABLE . Use your up and down arrow keys to observe the range of values and how the y-values change. Here is one possible window you can use:

WINDOW -30 ENTER 30 ENTER 10 ENTER -50000

ENTER 50000 ENTER 10000 GRAPH

This viewing window shows all the important feature of the graph. The TABLE function is very helpful when trying to find a good viewing window.

STUDENT PRACTICE

(1) Evaluate: $6 + \frac{1}{3} - 5 \div 7$

(2) Evaluate $\frac{15}{16} - \frac{7}{24}$ and express the answer as a fraction.

(3) Evaluate: $\sqrt{6} + 2 \cdot 6 - 1$

(4) Use the previous expression to evaluate $-\sqrt{3} + 2 \cdot 3 - 1$

(5) Evaluate: $(1.5)^3$

(6) Evaluate $-9(1.5)^3$ by using the previous answer. (This can be done with only 4 key strokes.)

(7) Evaluate $3x^2 - 5x + 6$ when

(a) $x = 2$ and (b) $x = -5$

Use the ENTRY, DEL, and INS keys or the TABLE function.

(8) Evaluate: $\frac{\ln 6}{5^2 - |-3|}$

(9) Evaluate: $\frac{4 - \sqrt[3]{15}}{5^4 + 7}$

(10) Evaluate: e^{123}

(11) Graph using the standard viewing window: $y = -3x^2 + 2x + 1$

Use the TRACE key to find the missing coordinate of the ordered pair (1.4893617, _____).

(12) Graph using the standard viewing window: $y = -|x + 2| - 3$

Use the TRACE key to find the y-intercept.

(13) Graph using the standard viewing window: $y = 5x^3 - 3x$, $y = 1 - 0.25x^2$

At how many points do these graphs intersect? Use the ZOOM key to verify your answer.

For problems (14) - (16), find a viewing window that contains all the important features of the graph. Use the TABLE key to help. (There are many possible answers.)

(14) $y = 16x^5 - 20x^3 + 5x$

(15) $y = 9x^2 + 6x + 11$

(16) $y = x^4 - 85x^2$

Student Practice Answer Key

(1) 5.619047619

(2) 31/48

(3) 13.44948974

(4) 3.267949192

(5) 3.375

(6) -30.375

(7) (a) 8
(b) 106

(8) 0.0814436122

(9) 0.0024268796

(10) $2.619517319 \times 10^{53}$

(11) -2.675871

(12) -5

(13) 1

Answers for (14) - (16) are given in the form:

[xmin, xmax; xscl] by [ymin, ymax; yscl]

These answers represent only one of **many** possible answers.

(14) [-1.5, 1.5; 0.5] by [-10, 10; 1]

(15) [-10, 10; 1] by [-200, 1000; 100]

(16) [-12, 12; 1] by [-2000, 2000; 200]

TI-83 ADVANCED FUNCTIONS

Evaluating Function Values

Example 1: For $f(x) = -9x^3 + 7x^2 - 5x + 1$, evaluate $f(-3)$.

Graph $f(x)$. To calculate $f(-3)$, follow the key strokes below.

CALC

[2nd] [ ] [1] [-3] [ENTER] .

The calculator will display $f(-3)$ as y. Therefore, $f(-3) = 322$.

Example 2: For $f(x) = 3x^2 - 5x + 6$ and $g(x) = -6x^3 + 12x$,

find $f(-3) - g(4)$.

Enter $f(x)$ as Y_1 and $g(x)$ as Y_2 (don't graph) and return to the home screen. Follow the keystrokes below.

[VARS] [▷] [1] [1] [(] [-3] [)] [-] [VARS] [▷] [1] [2] [(] [4] [)]

[ENTER] .

The answer is 384.

Finding the Zero of a Function

Example: Find the zero of $f(x) = 9x^3 + 7x^2 - 5x + 3$.

Graph $f(x)$ in the standard viewing window. You should see one negative zero. To find an approximation of this zero, use the CALC menu and follow these steps.

(1) Press [2nd] [CALC] [2]

(2) Type an x-value to the left of the zero such as [-2] and press [ENTER] to give the calculator a left bound.

(3) Type an x-value to the right of the zero such as [0] and press [ENTER] to give the calculator a right bound.

(4) Press [ENTER] to give the calculator a guess.

The zero is -1.364154.

Finding Minimum and Maximum Values

Example: Find the local minimum and maximum values of the function

$$f(x) = 3x^3 + 2x^2 - 9x - 3 \ .$$

Graph f(x) in the standard viewing window. To find the local minimum and local maximum, use the CALC menu and follow these steps.

To find the **local minimum**:

(1) Press [2nd] [CALC] [3]

(2) Type an x-value to the left of the x-value of the local minimum such as [0] and press [ENTER] to give the calculator a left bound.

(3) Type an x-value to the right of the x-value of the local minimum such as [2] and press [ENTER] to give the calculator a right bound.

(4) Press [ENTER] to give the calculator a guess.

The local minimum is the y-value -7.384043.

To find the **local maximum**:

CALC

(1) Press [2nd] [ ] [4]

(2) Type an x-value to the left of the x-value of the local maximum such as [-2] and press [ENTER] to give the calculator a left bound.

(3) Type an x-value to the right of the x-value of the local maximum such as [0] and press [ENTER] to give the calculator a right bound.

(4) Press [ENTER] to give the calculator a guess.

The local maximum is the y-value 5.5157307.

Finding the Intersection of Two Graphs

Example: Find all points of intersection of $y = 2x^2 + x - 2$ and $y = 2x + 3$.

Graph the two equations as Y_1 and Y_2 in the standard viewing window. There are two points of intersection. Follow these steps to find them.

(1) Press [2nd] [CALC] [5]

(2) Press [ENTER] [ENTER] to select curve 1 and curve 2.

(3) Use the left or right arrow key to position the cursor on the left point of intersection and press [ENTER] to give the calculator a guess. The answer for the left point of intersection is (-1.350781, 0.29843788).

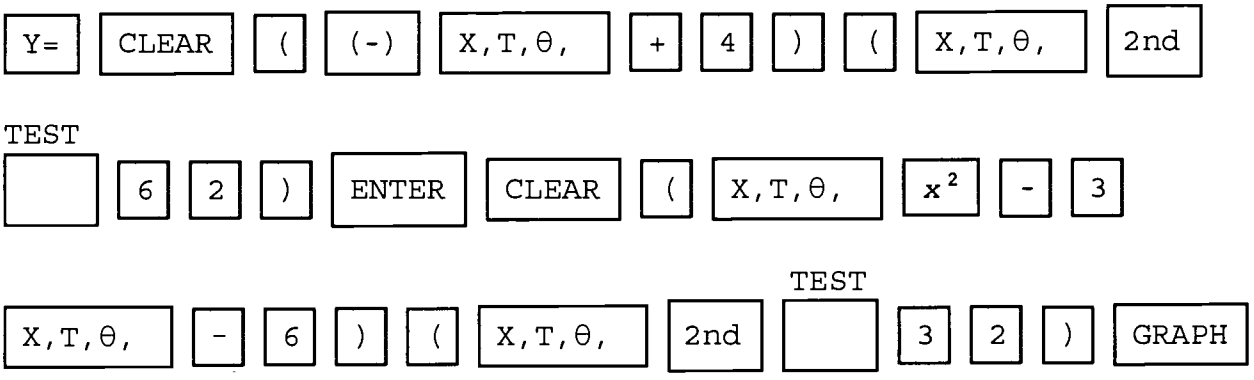
Use the same procedure to obtain the right point of intersection. The answer is (1.8507811, 6.7015621).

Graphing Piecewise-defined Functions

Example 1: Graph the piecewise-defined function

$$f(x) = \begin{cases} -x + 4 & \text{if } x \le 2 \\ x^2 - 3x - 6 & \text{if } x > 2 \end{cases}$$

Graph this function in the standard viewing window.

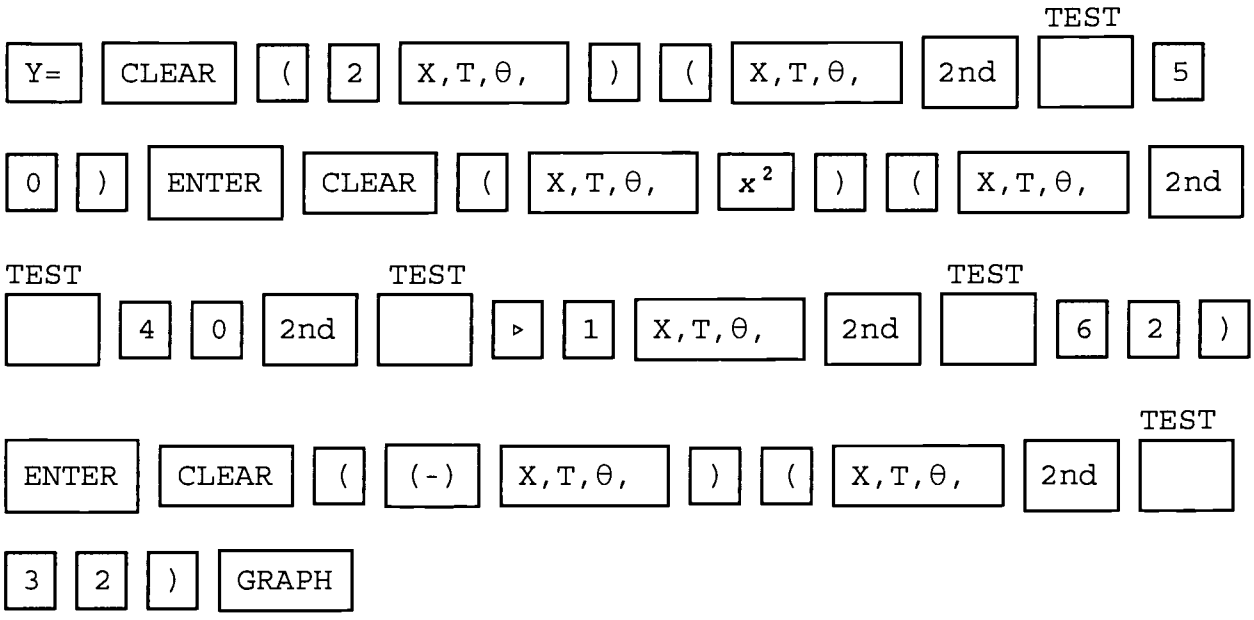


Each piece of the function is graphed separately for the values of x specified. The vertical lines in the middle are not part of the graph. The cursor is not able to jump vertically from one part of the screen to another. For piecewise-define functions where it needs to jump, it leaves a vertical line in its path.

Example 2: Graph the piecewise-defined function

$$f(x) = \begin{cases} 2x & \text{if } x < 0 \\ x^2 & \text{if } 0 \le x \le 2 \\ -x & \text{if } x > 2 \end{cases}$$

To graph this function, use the following keystrokes:


TEST
Y= CLEAR (2 X,T,θ,) (X,T,θ, 2nd 5
0) ENTER CLEAR (X,T,θ, x²) (X,T,θ, 2nd
TEST TEST TEST
4 0 2nd ▷ 1 X,T,θ, 2nd 6 2)
TEST
ENTER CLEAR ((-) X,T,θ,) (X,T,θ, 2nd
3 2) GRAPH

Scatter Plots and Linear Regression

Example: For the following data, use the TI83 to graph a scatter plot, find an equation of the line that best fits the data, and graph this equation with the scatter plot.

Eight randomly selected people performed exercise tests and recorded their peak heart rates. Their peak heart rates and ages are shown below.

Age	Peak Heart Rate
30	186
38	183
29	191
39	177
46	175
41	176
42	171
24	196

To enter data into the calculator, press [STAT] [1] . If list L1 already contains data, position the cursor on L1 and press [CLEAR] [ENTER] . Do the same for list L2 if needed. Position cursor on the first space in list L1 and type in each age value pressing [ENTER] after each value. Press [▷] to enter data into list L2. Type in each peak heart rate value pressing [ENTER] after each value.

To graph a scatter plot, press [Y=] and use the CLEAR key to delete any equations. If Plot1, Plot2, or Plot3 is selected (highlighted), position the cursor on it and press enter to deselect it. Press [2nd] [STAT PLOT] [1] to graph the scatter plot as Plot1. Press [ENTER] to turn on Plot1. If needed, select the first graph type by positioning the cursor on it and pressing [ENTER]. Make sure the Xlist is L1 and the Ylist is L2. If not, position the cursor over the current list for the Xlist and press [2nd] [L1]. Follow the same procedure to obtain L2 for the Ylist. You have now indicated that the age data in list L1 is represented by the variable x and the heart rate data in list L2 is represented by the variable y. Lastly, select the plus sign in the Mark row by positioning the cursor on it and pressing [ENTER]. Graph the scatter plot by pressing [ZOOM] [9].

To find the equation of the line that best fits this data and to graph the line as Y_1, use the linear regression option under the STAT menu by pressing

[STAT] [▸] [4] [2nd] [L1] [)] [2nd] [L2] [)] [VARS] [▸] [1] [1]

ENTER

A list of the slope(labeled "a") and the y-intercept(labeled "b") is obtained. Therefore, the equation of the line is(rounding to the nearest hundredth)

$$y = -1.08x + 220.78$$

To graph this equation with the scatter plot, press GRAPH .

Graphing Parametric Equations

Example: Graph $x = t^2$, $y = -3t + 2$, $-2 \leq t \leq 2$

Change to parametric mode:

[MODE] [▽] [▽] [▽] [▷] [ENTER]

Type in the equations:

[Y=] [X,T,θ,] [x^2] [ENTER] [-3] [X,T,θ,] [+] [2]

The domain of the parameter t must be adjusted (as defined in the problem) as well as the viewing window.

[WINDO] [-2] [ENTER] [2] [ENTER] [.1] [ENTER] [-10] [ENTER] [10]

[ENTER] [1] [ENTER] [-10] [ENTER] [10] [ENTER] [1] [ENTER]

[GRAPH]

Simplifying Matrices to Row Echelon Form

Example: Simplify the augmented matrix to row echelon form.

$$\begin{bmatrix} 2 & 4 & 9 \\ 1 & -1 & 3 \end{bmatrix}$$

Enter the augmented 2 by 3 matrix as matrix A.

[MATRX] [▷] [▷] [1] [2] [ENTER] [3] [ENTER]

[2] [ENTER] [4] [ENTER] [9] [ENTER]

[1] [ENTER] [-1] [ENTER] [3] [ENTER]

Return to the home screen.

To obtain row echelon form, perform elementary row operations.

(1) To obtain a "1" in the row 1 column 1 position, interchange rows 1 and 2. This is option "C" under the MATRIX MATH menu. Option "C" is not visible initially. Use your down arrow key to see it.

C

[MATRX] [▷] [ALPHA] [ ] [MATRX] [1] [,] [1] [,] [2] [)] [ENTER]

You should obtain the matrix $\begin{bmatrix} 1 & -1 & 3 \\ 2 & 4 & 9 \end{bmatrix}$.

(2) To obtain a "0" in the row 2 column 1 position, multiply row 1 by -2 and add it to row 2. This is option "F" under the MATRIX MATH menu(use your down arrow key to see it).

F ANS

[MATRX] [▷] [ALPHA] [ ] [-2] [,] [2nd] [ ] [,] [1] [,] [2] [)]

ENTER

You should obtain the matrix $\begin{bmatrix} 1 & -1 & 3 \\ 0 & 6 & 3 \end{bmatrix}$.

(3) To obtain a "1" in the row 2 column 2 position, multiply row 2 by 1/6 . This is option "E" under the MATRIX MATH menu(use your down arrow key to see it).

E ANS

MATRX ▷ ALPHA [ ] 1 ÷ 6) 2nd [ ]) 2)

ENTER

The answer is the matrix $\begin{bmatrix} 1 & -1 & 3 \\ 0 & 1 & .5 \end{bmatrix}$.

Finding the Determinant of a Matrix

Example: Find the determinant of $\begin{bmatrix} 0 & 2 & 1 \\ 3 & -1 & 2 \\ 4 & 0 & 1 \end{bmatrix}$

Enter the 3 by 3 matrix as matrix A.

[MATRX] [▷] [▷] [1] [3] [ENTER] [3] [ENTER]

[0] [ENTER] [2] [ENTER] [1] [ENTER]

[3] [ENTER] [-1] [ENTER] [2] [ENTER]

[4] [ENTER] [0] [ENTER] [1] [ENTER]

To find the determinant, return to home screen and press

[MATRX] [▷] [1] [MATRX] [1] [)] [ENTER]

The answer is 14.

Multiplying Matrices

Example: Multiply: $\begin{bmatrix} 2 & 4 \\ 0 & -1 \\ -3 & 1 \end{bmatrix} \begin{bmatrix} -2 \\ 5 \end{bmatrix}$

Enter the first matrix as [A] and the second matrix as [B].

[MATRX] [▷] [▷] [1] [3] [ENTER] [2] [ENTER]

[2] [ENTER] [4] [ENTER]

[0] [ENTER] [-1] [ENTER]

[-3] [ENTER] [1] [ENTER]

[MATRX] [▷] [▷] [2] [2] [ENTER] [1] [ENTER]

[-2] [ENTER] [5] [ENTER]

Multiply matrix [A] by matrix [B].

QUIT

[2nd] [ ] [MATRX] [1] [MATRX] [2] [ENTER]

The answer is $\begin{bmatrix} 16 \\ -5 \\ 11 \end{bmatrix}$.

Finding the Inverse of a Matrix

Example: Find the inverse of the 2 by 2 matrix $\begin{bmatrix} 2 & -2 \\ 0 & 1 \end{bmatrix}$

Enter this matrix as matrix A.

[MATRX] [▷] [▷] [1] [2] [ENTER] [2] [ENTER]

[2] [ENTER]

[-2] [ENTER]

[0] [ENTER]

[1] [ENTER]

To find the inverse of matrix A, written $[A]^{-1}$, press

QUIT

[2nd] [ ] [MATRX] [1] [X^{-1}] [ENTER]

The answer is $[A]^{-1} = \begin{bmatrix} .5 & 1 \\ 0 & 1 \end{bmatrix}$.

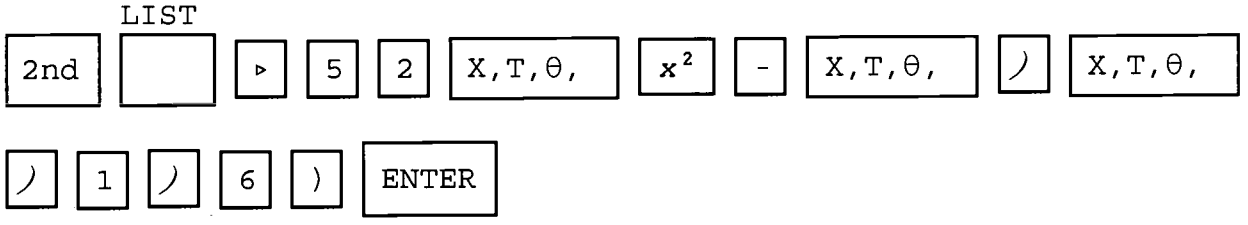
Finding Terms of a Sequence

Example: Find the first 6 terms of the sequence $a_n = 2n^2 - n$.

Use the sequence function with the syntax:

seq(sequence, variable, min variable value, max variable value)

For this example, the syntax would be seq($2x^2$ - x, x, 1, 6) which can be obtained as follows:

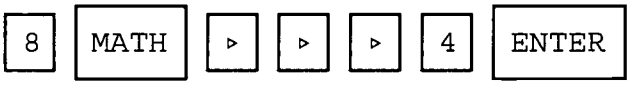


Use the left and right arrow keys to scroll through the list. The answers are 1, 6, 15, 28, 45, 66.

Factorials and Binomial Coefficients

Example 1: Evaluate 8!

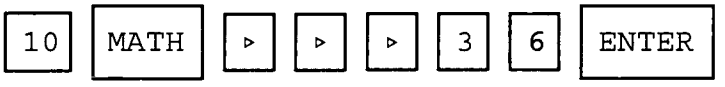
To evaluate this factorial, follow the keystrokes below.



The answer is 40,320 .

Example 2: Evaluate $\binom{10}{6}$

To evaluate this binomial coefficient, follow the keystrokes below.



The answer is 210.

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